

REMARKS

In the Office Action mailed December 11, 2006, claims 1-9, 14-18, 20-31, 33-42, 47-51, 53-64 and 66 were rejected and claims 10-13, 19, 32, 43-46, 52 and 65 were objected to.¹ Claims 34-66 were rejected under 35 U.S.C. §101 as failing to produce a real life, real world, useful, concrete and tangible result. Claims 1-2, 4-9, 14-18, 20-28, 30, 31, 33-35, 37-42, 47-51, 53-61, 62-64 and 66 were rejected under 35 U.S.C. §102(b) as being anticipated by Cusumano et al. (U.S. Pat. No. 6,567,752). Claims 3, 29, 36 and 62 were rejected under 35 U.S.C. §103(a) as being obvious over Cusumano et al. in view of Discoenzo (U.S. Pat. No. 6,847,854). Claims 10-13, 19 and 32 were objected to as depending from a rejected base claim, but were indicated to be allowable if rewritten in independent form. Claims 43-46, 52 and 65 were objected to as depending from a rejected base claim, but were indicated to be allowable if rewritten in independent form.²

With the present amendment, dependent claim 13 has been canceled. New independent claim 67 has been added. New independent claim 67 is generally similar to original independent claim 1 with a Markush group limitation added that corresponds to the language of original dependent claims 10-13, which were indicated to be allowable over the prior art of record.

Interview Summary

A telephone interview was conducted between Examiner Aditya Bhat and Austen Zuege for Applicant to clarify the claims that were rejected and those that were indicated to be allowable. Examiner Bhat indicated that claims 10-13, 19, 32, 43-46, 52 and 65 would be allowable if the stated objections were overcome, as indicated on pages 10-11 of the 12/11/2006 Office Action, and that the rejections of those claims indicated to be allowable stated elsewhere in the Office Action were stated in

¹As clarified below, the Office Action contained some typographical error regarding the claims identified as rejected and allowed.

²It is assumed that the allowability of claims 43-46, 52 and 65 also requires overcoming the rejections under §101.

error and should be disregarded. Furthermore, the indication on page 11 that claims 2-8 were allowed was in error, and the rejections of those claims stated elsewhere in the Office Action stand.

Claim Objections

Claims 10-13, 19, 32, 43-46, 52 and 65 were objected to as depending from a rejected base claim, but were indicated to be allowable if rewritten in independent form. Applicants acknowledge the allowability of those dependent claims over the prior art of record, and note that claim 13 has now been canceled making the rejection of that claim moot. Also, as discussed below, amended independent claims 1 and 34, from which claims 10-12, 19, 32, 43-46, 52 and 65 depend, are now in condition for allowance. Moreover, as discussed below, claims 34-66 are allowable under §101. Therefore, the objections to claims 10-13, 19, 32, 43-46, 52 and 65 should be withdrawn. Notification to that effect is requested.

Claim Rejections - 35 U.S.C. §101

Claims 34-66 were rejected under 35 U.S.C. §101 as failing to produce a real life, real world, useful, concrete and tangible result.

Amended independent claim 34 includes a step directed to "producing an assessment of operational health for said machinery based on said measurements using said processor." The "assessment of operational health" produced by this step constitutes a tangible output of the claimed method, and distinguishes the claimed method from the mere manipulation of data. The assessment of operational health is tangible in the sense that it is an output capable of being apprehended by a user or device. Thus, the rejection of amended independent claim 34 under §101 should be withdrawn, and notification to that effect is requested.

Claims 35-66 depend from amended independent claim 34 and include all of the limitations of that base claim. Therefore, dependent claims 35-66 are likewise in condition for allowance for the reasons stated above, and the rejections under §101 should be withdrawn. Notification to that effect is requested.

Claim Rejections - 35 U.S.C. §102(b)

Claims 1-2, 4-9, 14-18, 20-28, 30, 31, 33-35, 37-42, 47-51, 53-61, 62-64 and 66 were rejected under 35 U.S.C. §102(b) as being anticipated by Cusumano et al. (U.S. Pat. No. 6,567,752).

Amended independent claim 1 relates to a system for monitoring rotating machinery, and requires a plurality of proximeters positioned proximate to the rotating machinery and each being operable to measure and transmit resonant vibration frequency and amplitude data for the rotatable machinery derived from a transit time between individual rotating extensions of the rotating machinery, along with signal amplitude data for a proximeter signal. According to amended independent claim 1, the plurality of proximeters are positioned so as to enable mapping of substantially an entire resonance period of said rotating machinery.

Amended independent claim 34 relates to a method for monitoring rotating machinery, and requires positioning a plurality of proximeters proximate to the rotating machinery, where the proximeters are each operable to measure and transmit resonant vibration and amplitude data for the rotating machinery derived from a transit time between individual rotating extensions of the rotating machinery, along with signal amplitude data for a proximeter signal. The method of amended independent claim 34 includes receiving and correlating said data using a processor that is electrically coupled to said plurality of proximeters to map substantially an entire resonance period of said rotating machinery and produce an assessment of operational health for the machinery based on the measurements using the processor.

It is important to note that amended independent claims 1 and 34 both require proximeters that are each operable to measure and transmit two types of data: (a) resonant vibration and amplitude data derived as a function of a transit time between individual rotating extensions of the rotating machinery and (b) signal amplitude data for a proximeter signal. Independent claims 1 and 34 have both been amended to clarify that resonant vibration and amplitude data relates to a characteristic of the rotating machinery being monitored, while the signal amplitude data, in contrast, is a property of a proximeter signal. Resonant vibration data of the rotating machinery, including both machinery vibration frequency and machinery

vibration amplitude, is derived in the time domain from transit time data, which can be derived from the transit time between a given set of machinery features as they rotate. (Specification, ¶28). The signal amplitude data, on the other hand, is derived from signal strength from a proximeter signal generated by the proximeter, such as a signal amplitude measurement in millivolts. (Specification, ¶29). In this respect, the resonant vibration data is a physical or mechanical property of the rotating machinery being monitored, while the signal amplitude data is an electrical, electromagnetic, or other type of property related to the operation of the proximeter (although the present invention contemplates that different types of proximeters can be utilized). This distinction has been clarified in the language of amended independent claims 1 and 34, as requested at page 10 of the Office Action.

Cusumano et al. discloses a method and apparatus for tracking the evolution of hidden damage or otherwise unwanted changes in machinery components and predicting remaining useful life. According to Cusumano et al., "fast" subsystem data is gathered to predict "slow" subsystem data, which allows monitoring of slow-to-develop damage. (Cusumano et al., col. 1, ll. 12-17; col. 4, ll. 6-26). In FIG. 2 of Cusumano et al., a test system 200 and a cantilevered beam 205 are shown, with the beam 205 constituting a test object attached to a strain gauge 220 and a shaker 225 of the system 200. (Cusumano et al., col. 11, ll. 22-36; FIG. 2). The Office Action states that Cusumano et al. teaches the use of a variety as well as a plurality of sensors. (12/11/2006 Office Action, p. 10; citing Cusumano et al., col. 12, ll. 59-63).

Here, Cusumano et al. fails to show, teach or disclose each and every element of independent claims 1 and 34 because Cusumano et al. fails to show, teach or disclose any apparatus or method for measuring and transmitting the two distinct types of data required by independent claims 1 and 34: (a) resonance data for the rotating machinery and (b) signal amplitude data for a proximeter signal. In this respect, as discussed above, amplitude as it relates to *resonance data for the rotating machinery*, is not the same as *signal amplitude data for a proximeter signal*.

Furthermore, the new language of amended independent claims 1 and 34 specifies that the plurality of proximeters map substantially an entire resonance period of said rotating machinery. This new language specifies a particular configuration of the plurality of proximeters that is more detailed than anything disclosed, taught or suggested by Cusumano et al., which does not disclose, teach or suggest positioning proximeters with respect to the resonance period of test objects. *See* M.P.E.P. 2131, citing *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989). The configuration and method of amended independent claims 1 and 34 distinguish the present invention from other configurations and methods where only a single data point or limited sets of data points are mapped. (See specification, ¶23).

Thus, Cusumano et al. fails to show, teach or disclose each and every limitation of amended independent claims 1 and 34, and the rejections under §102 should be withdrawn. Notification to that effect is requested.

Claims 2, 4-9, 14-18, 20-28, 30, 31 and 33 depend from independent claim 1 and include all of the limitations of that base claim, and claims 35, 37-42, 47-51, 53-61, 62-64 and 66 depend from independent claim 34 and include all of the limitations of that base claim. For the reasons detailed above with respect to independent claims 1 and 34, all of the dependent claims 2, 4-9, 14-18, 20-28, 30, 31, 33, 35, 37-42, 47-51, 53-61, 62-64 and 66 are also allowable over the cited art, and the rejections under §102 should likewise be withdrawn.

In addition, Cusumano et al. fails to show, teach or disclose many limitations recited in the pending dependent claims. The following are some examples.

Regarding amended dependent claim 16, Cusumano et al. fails to show, teach or disclose first and second proximeters that are orientated at about 90° to each other. Providing proximeters that are, for example, radially and axially oriented with respect to an axis of rotation of machinery facilitates monitoring desired operational health characteristics. (See, e.g., specification, ¶¶ 22, 23, 28, 41; FIGS. 1, 3a, 3b, 10). Cusumano et al. lacks any disclosure regarding the particular orientations of proximeters in relation to each other. Thus, the rejection of amended dependent claim 16 should be withdrawn.

Regarding dependent claims 33 and 66, Cusumano et al. does not show, teach or disclose proximeters that are spaced at odd harmonics of the resonance frequency quarter wavelength of teeth of a gear of a gearbox, which comprises the rotating machinery being monitored. Cusumano et al. does not disclose resonance frequencies of gears in a gearbox being monitored, or positioning proximeters at odd harmonics of the resonance frequency quarter wavelength for gear teeth. Dependent claims 33 and 66 suggest a specific configuration of proximeters not contemplated or suggested by Cusumano et al. Thus, the rejections of amended dependent claims 33 and 66 should be withdrawn.

Applicant also maintains arguments made previously with respect to other dependent claims currently rejected.

Regarding dependent claims 4 and 37, the term "runout" (i.e., radial runout) refers to a measure of how a rotating shaft deviates from being truly round. (*See, e.g.,* Sarr, U.S. Pat. No. 7,026,637, col. 1, ll. 11-14). The Office Action cited a passage in Cusumano et al. against claims 4 and 37 that discusses crack growth in a shaft. (12/11/2006 Office Action, p. 4, citing Cusumano et al., col. 4, ll. 35-42). Crack growth monitoring is unrelated to runout data. Cusumano et al. therefore fails to show, teach or disclose resonant vibration data that includes radial runout data for a shaft having circumferentially disposed extensions, where the resonant vibration data is derived from transit times between individual rotating extensions. Thus, the rejections of dependent claims 4 and 37 should be withdrawn. Likewise, Cusumano et al. fails to show, teach or disclose runout data as required by dependent claims 5, 6, 38, 39 and 41.

Regarding dependent claims 7, 9 and 40, Cusumano et al. does not disclose measurement, transmittal or correlation involving axial movement data, which can be runout data, radial displacement of an axis of rotation, or other fluctuations in position induced by the position of a load-bearing shaft. Contrary to the assertions in the December 11, 2006 Office Action, Cusumano et al. does not show, teach or disclose those claim limitations. The passages of Cusumano et al. cited in the Final Office Action fail to

disclose any data relating to axial movement. (12/11/2006 Office Action, p. 4, citing Cusumano et al., col. 4, ll. 31-42 and col. 12, ll. 58-65). Thus, the rejections should be withdrawn.

Regarding dependent claims 14, 17-18, 20, 47, 50-51 and 53, Cusumano et al. does not show, teach or disclose the particular locations of proximeters in relation to each other or to rotating machinery required by those various claims. Furthermore, as discussed above, Cusumano et al. does not disclose proximeters at all. Thus, the rejections should be withdrawn.

Claim Rejections - 35 U.S.C. §103(a)

Claims 3, 29, 36 and 62 were rejected under 35 U.S.C. §103(a) as being obvious over Cusumano et al. (U.S. Pat. No. 6,567,752) in view of Discoenzo (U.S. Pat. No. 6,847,854).

Claims 3 and 29 depend from amended independent claim 1 and include all of the limitations of that base claim, and claims 36 and 62 depend from amended independent claim 34 and include all of the limitations of that base claim. As discussed above with respect to the rejections under §102(b), amended independent claims 1 and 34 are patentable over Cusumano et al. Discoenzo does not supply the teaching lacking in Cusumano et al. Accordingly, dependent claims 3, 29, 36 and 62 are also patentable over the cited art. The rejections under §103 should be withdrawn. Notification to that effect is requested.

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CONCLUSION

It is believed that all of the pending claims are now in condition for allowance. The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

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